Geophysical Research Abstracts
Vol. 19, EGU2017-7535, 2017
EGU General Assembly 2017

GPS-derived surface imprint of toroidal flow at the Calabrian slab edges

Mimmo Palano (1), Claudia Piromallo (2), and Claudio Chiarabba (2)

(1) Istituto Nazionale di Geofisica e Vulcanologia, Osservatorio Etneo, Catania, Italy (mimmo.palano@ingv.it), (2) Istituto Nazionale di Geofisica e Vulcanologia, Rome, Italy

Tearing of the lithosphere and toroidal upper mantle circulation have been modeled and proposed at slab edges of several retreating subduction zones. While tear faults laterally decouple the subducting lithosphere during retreat and promote strike-slip motion in the overriding plate, toroidal flow around slab edges accommodates the displacement, from beneath the stiff slab, of less viscous mantle material towards the mantle wedge. Edge processes jointly contribute to surface crustal deformation, which can be revealed both by geodetic and geological observations. We document this effect in the Calabrian subduction system, where the Ionian slab rollback has been taking place since 30 Ma, following a step-wise process accompanied by migration of lithospheric tearing. We observe GPS velocities with symmetric toroidal patterns around the slab hinges: a counterclockwise rotation rate of $\sim$1.29 °/Ma around a pole located in the Sibari Gulf for the northern slab edge and a clockwise rotation rate of $\sim$1.74 °/Ma around a pole close to the NE Sicily coastal area at the southern slab edge. These small-scale, opposite rotations occur at complex sets of active faults representing the lithospheric tears currently accommodating the SE-ward migration of the subduction system. At depth, the mantle flow field imaged by seismic anisotropy reveals instead an asymmetry: a toroidal pattern of sub-slab return flow appears only at the southern slab edge, while at the northern end SKS-splitting fast directions are trench parallel. A possible cause for this asymmetric coupling of the upper plate deformation with underlying mantle flow is the immature stage of the northern slab tear.